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The Author.

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H.H. The Prince of Monaco.

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Sir Henry Roscoe, F.R.S.

Vogel (H. C.) Neuere Untersuchungen über die Spectra der Planeten. 8vo. *Berlin* 1895. The Author.

February 14, 1895.

Sir JOHN EVANS, K.C.B., D.C.L., LL.D., Vice-President and Treasurer, in the Chair.

The Right. Hon. Horace, Lord Davey, a Member of Her Majesty's Most Honourable Privy Council, was admitted into the Society.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "On some Considerations showing that Maxwell's Theorem of the Equal Partition of Energy among the Degrees of Freedom of Atoms is not inconsistent with the various Internal Movements exhibited by the Spectra of Gases." By Professor G. F. FITZGERALD, F.R.S. Received February 7, 1895.

It has been generally held that a sufficient freedom of internal motion in an atom to explain the spectra of gases proved that the theorem as to equal partition of energy among all degrees of freedom could not hold, and various suggestions have been made as to why the *proof*, as given by Maxwell, Boltzmann, and others, fails in this

case. Professor Schuster has suggested that the numerous lines need not involve the same number of degrees of freedom, as it is possible that there may be connections between them such that one or two co-ordinates would define a motion which when analysed into its Fourier components, as is done by a grating or prism, would produce a very complex system of lines. However, even one degree of internal freedom would interfere very seriously with the observed value of the ratio of specific heats, and the object of this letter is to explain how this difficulty may be surmounted without supposing that the theorem as to equal partition of energy is untrue, for it is not by any means disproved because a certain form of proof fails in certain cases.

It has been long held that the motion of the electrons on neighbouring atoms is very much controlled by the ether between them. The wave-length of light is generally many times as great as the molecular distances, so that the ether is a practically rigid connector between neighbouring electrons. Suppose now, as a particular example, that 10^6 atoms are in this sense, and so far as the motion of electrons is concerned, within one another's control. In this case the motion of these 10^6 electrons might be defined by means of, say, three co-ordinates. Hence, if the atoms were spheres, there would be 3×10^6 degrees of freedom plus these three degrees defining the motions of all the electrons. Now, if the total energy be equally distributed among all these degrees of freedom, each atom will only have its share of the electromotions, and its energy of external motion will only be diminished by 3×10^{-6}th part owing to the existence of the internal motion of its electrons. I need hardly say that our methods of calorimetry are by no means sufficiently delicate to detect anything of this kind. There might be a thousand such internal degrees of freedom, and yet the ratio of specific heats would agree with observation.

There is some analogy between this suggestion and the case of a sphere moving in a liquid. The presence of the liquid, although apparently endowed with an infinite number of degrees of freedom, does not really increase the degrees of freedom at all, because its motion is entirely defined by the motion of the sphere. In a somewhat similar manner, I would suggest that the presence of the million electrons does not sensibly increase the degrees of freedom of motion of the million atoms, as all their motions may be defined in terms of the motion of a few of them. That the ether would so control the motions of electrons seems almost certain from what we know of the rapidity with which electromagnetic actions are transmitted by it, showing how completely it behaves in respect of them as a system of rigid connections.